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Lake County, Florida

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Prepared for

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NATIONAL EUTROPHICATION SURVEY

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Report

on

Lake Griffin
Lake County
Florida

EPA Region IV

Working Paper No. 254

With the cooperation of the

Florida Department of Environmental Regulation

and the

Florida National Guard

October, 1977

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Florida Department of Environmental Regulation for professional involvement and to the Florida National Guard for conducting the tributary sampling phase of the Survey.

Joseph W. Landers, Jr., Secretary of the Department of Environmental Regulation; John A Redmond, former Director of the Division of Planning, Technical Assistance, and Grants; and Dr. Tim S. Stuart, Chief of the Bureau of Water Quality, provided invaluable lake documentation and counsel during the survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

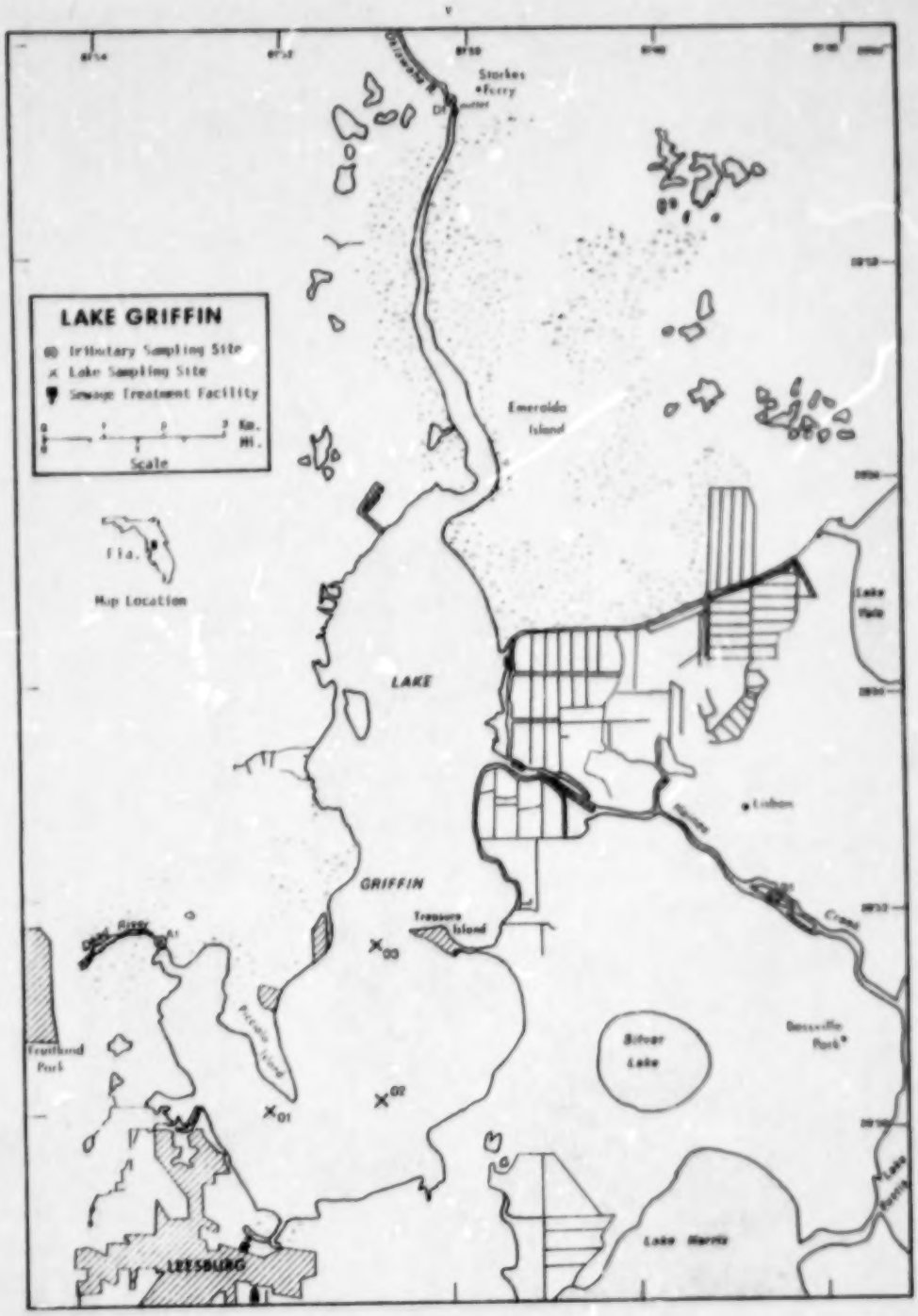
Major General Henry W. McMillan (Retired), then the Adjutant General of Florida, and Project Officer Colonel Hugo F. Windham, who directed the volunteer efforts of the Florida National Guard, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF FLORIDA

LAKE NAME	COUNTY
Alligator	Columbia
Apopka	Lake, Orange
Banana	Polk
Crescent	Flagler, Putnam
Doctors	Clay
Dora	Lake
East Tohopekaliga	Osceola
Effie	Polk
Eloise	Polk
George	Putnam, Volusia
Gibson	Polk
Glenada	Highlands
Griffin	Lake
Haines	Polk
Hancock	Polk
Horseshoe	Seminole
Howell	Orange, Seminole
Istokpoga	Highlands
Jessie	Polk
Jessup	Seminole
Kissimmee	Osceola
Lawne	Orange
Lulu	Polk
Marion	Polk
Minnehaha	Orange
Minneola	Lake
Monroe	Seminole, Volusia
Munson	Leon
Okeechobee	Glades, Hendry, Martin, Okeechobee, Palm Beach
Poinsett	Brevard, Orange, Osceola
Reedy	Polk
Seminole	Jackson, FL; Decatur, Seminole, GA
Seminole	Pinellas
South	Brevard
Talquin	Gadsden, Leon
Tarpon	Pinellas
Thonotosassa	Hillsborough
Tohopekaliga	Osceola
Trout	Lake
Weohyakapka	Polk
Yale	Lake


LAKE GRIFFIN
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Scale
Fla.
Map Location
Stokes Ferry
Emeralda Island
LAKE
GRIFFIN
Treasure Island
Silver Lake
Lake Harris
LEESBURG

LAKE GRIFFIN

STORET NO. 1214

I. CONCLUSIONS

A. Trophic Condition:

Survey data and reports by others (Ketelle and Uttormark, 1971; Shannon and Brezonik, 1972) indicate that Lake Griffin is highly eutrophic. It ranked 24th in overall trophic quality when the 41 Florida lakes sampled in 1973 were compared using a combination of six parameters*. Twenty-one of the lakes had less median total and dissolved phosphorus, 21 had less and three had the same median inorganic nitrogen, 28 had less mean chlorophyll a, and 31 had greater mean Secchi disc transparency.

The numbers of blue-green algae in all phytoplankton samples confirm the trophic assessment (see page 7).

B. Rate-Limiting Nutrient:

Due to loss of nitrogen in the sample between the time of collection and the beginning of the algal assay, the results are not representative of conditions in the lake at the time the sample was taken (03/14/73).

The lake data indicate phosphorus limitation in March but nitrogen limitation in September and November.

C. Nutrient Controllability:

1. Point sources--It is calculated that point sources contributed 48.0% of the total phosphorus and 8.2% of the total nitrogen inputs to Lake Griffin during the sampling year. Agri-

* See Appendix A.

cultural sources (muck farm and livestock) collectively contributed 40.1% of the total phosphorus load, the Leesburg wastewater treatment plant contributed 7.8%, and lakeshore septic tanks were estimated to have contributed less than 1%.

Since the Survey sampling year, nearly 34% of the muck farm pumping capacity (261.2 m^3/min) and the Cattlemaster Farms discharge have been diverted to retention ponds (Wicks, 1977). It is calculated that these improvements have reduced the Lake Griffin total phosphorus loading by 7,190 kg/yr and the areal loading from the sampling year 1.41 g/m^2 to 1.21 g/m^2/yr. When the remaining muck farm pumpage is retained, the total phosphorus load will be reduced by an additional 13,000 kg/yr, and the areal loading will be reduced to 0.85 g/m^2/yr. Removal of 85% of the effluent phosphorus load at the Leesburg wastewater treatment plant would further reduce the areal loading to 0.75 g/m^2/yr.

While a 0.75 g/m^2/yr total phosphorus loading would still exceed the 0.56 g/m^2/yr proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading, the reductions noted above should result in an improvement in the trophic condition of Lake Griffin since the critical phosphorus level for the lake may be somewhat higher than that suggested by Vollenweider (see page 13), and the Haines Creek contribution probably has been reduced to some degree from that measured during the sampling year (see discussion below).

2. Non-point sources--It is estimated that 52.0% of the total phosphorus and 91.8% of the total nitrogen inputs to Lake Griffin

were contributed by non-point sources.

Haines Creek contributed 39.8% of the total phosphorus load and 76.2% of the total nitrogen load, although the nutrient export rates of this stream were relatively low (12 kg P and 413 kg N per square kilometer of drainage area during the sampling year; see page 12). However, it is likely that the nutrient exports of the creek are somewhat less now because of controls instituted upstream in the Oklawaha Chain of Lakes drainage (e.g., muck farm pumpage at Lake Apopka*) since the Survey sampling was completed.

* Working Paper No. 244.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 35.60 kilometers^2.

2. Mean depth: 2.9 meters.

3. Maximum depth: 4.6 meters.

4. Volume: 103.240 X 10^6 m^3.

5. Mean hydraulic retention time: 124 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Dead River	11.3	0.06
Haines Creek	1,678.3	8.36
Minor tributaries & immediate drainage -	282.0	1.21
Totals	1,971.6	9.63

2. Outlet -

Oklawaha River	2,007.2**	9.62

C. Precipitation***:

1. Year of sampling: 121.6 centimeters.

2. Mean annual: 132.1 centimeters.

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† Table of metric conversions--Appendix A.
†† Morphometry from contour map of Lake Griffin prepared by the Florida Game and Fresh Water Fish Commission.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Lake Griffin was sampled three times during 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from one or more depths at each station (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depth sampled at each station was 1.2 meters.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE GRIFFIN
STORET CODE 1214

PARAMETER	1ST SAMPLING (3/14/73) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (9/ 6/73) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (11/ 5/73) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	25.3 - 26.2	25.7	25.5	29.4 - 29.7	29.5	29.4	22.1 - 23.0	22.6	22.7
DISS OXY (MG/L)	9.1 - 9.3	9.2	9.1	8.4 - 9.2	8.7	8.6	8.8 - 9.6	9.0	8.9
CNDCTVY (MCROMO)	285. - 290.	288.	290.	292. - 298.	294.	292.	260. - 267.	263.	263.
PH (STAND UNITS)	9.2 - 9.4	9.3	9.3	8.9 - 9.0	9.0	9.0	8.7 - 9.0	8.8	8.9
TOT ALK (MG/L)	99. - 102.	100.	100.	86. - 98.	91.	88.	98. - 103.	101.	101.
TOT P (MG/L)	0.095 - 0.102	0.099	0.099	0.083 - 0.122	0.100	0.095	0.116 - 0.157	0.134	0.126
ORTHO P (MG/L)	0.012 - 0.013	0.012	0.012	0.026 - 0.030	0.028	0.027	0.047 - 0.060	0.053	0.053
NO2+NO3 (MG/L)	0.160 - 0.170	0.163	0.160	0.100 - 0.110	0.107	0.110	0.130 - 0.170	0.143	0.140
AMMONIA (MG/L)	0.150 - 0.180	0.170	0.170	0.090 - 0.090	0.090	0.090	0.110 - 0.140	0.123	0.120
KJEL N (MG/L)	2.200 - 3.300	2.667	2.500	3.600 - 4.000	3.800	3.800	3.000 - 3.600	3.267	3.250
INORG N (MG/L)	0.320 - 0.340	0.333	0.340	0.190 - 0.200	0.197	0.200	0.240 - 0.310	0.267	0.260
TOTAL N (MG/L)	2.360 - 3.470	2.833	2.550	3.710 - 4.110	3.907	3.900	3.150 - 3.770	3.410	3.380
CHLRPYL A (UG/L)	12.4 - 28.0	22.4	28.0	74.0 - 117.8	99.2	105.9	58.2 - 94.8	78.5	82.6
SECCHI (METERS)	0.4 - 0.5	0.3	0.3	0.4 - 0.6	0.5	0.4	0.3 - 0.5	0.4	0.4

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
03/14/73	1. *Lyngbya sp.*	65,151
	2. *Microcystis sp.*	37,360
	3. *Dactylococcopsis sp.*	8,755
	4. *Synedra sp.*	2,850
	5. *Oscillatoria sp.*	2,647
	Other genera	7,432
	Total	124,195
09/06/73	1. *Lyngbya sp.*	140,350
	2. *Oscillatoria sp.*	108,500
	3. *Achnanthes sp.*	13,300
	4. Blue-green filaments	8,400
	5. *Aphanocapsa sp.*	4,550
	Other genera	25,550
	Total	300,650
11/05/73	1. *Lyngbya sp.*	174,650
	2. *Dactylococcopsis sp.*	20,961
	3. *Aphanothece sp.*	20,300
	4. *Microcystis sp.*	20,300
	5. Blue-green filaments	18,900
	Other genera	88,430
	Total	343,541

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (μg/l)
03/14/73	1	12.4
	2	28.0
	3	28.0
09/06/73	1	74.0
	2	105.9
	3	117.8
11/05/73	1	58.2
	2	82.6
	3	94.8

C. Limiting Nutrient Study:

There was a loss of about 53% of the inorganic nitrogen in the algal assay sample during shipment to the laboratory. Therefore, the assay results are not representative of conditions in the lake at the time of sample collection (03/14/73).

The lake data indicate phosphorus limitation at all stations in March but nitrogen limitation at all stations in September and November. Following is a tabulation of the mean inorganic nitrogen/orthophosphorus ratios for each of the stations and sampling times with the indicated limiting nutrient in parentheses.

Station	03/14/73	09/06/73	11/05/73
1	26/1 (P)	7/1 (N)	6/1 (N)
2	27/1 (P)	7/1 (N)	5/1 (N)
3	28/1 (P)	7/1 (N)	5/1 (N)

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Florida National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v). Sampling was begun in March, 1973, and was completed in February, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Florida District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient loads, in $kg/km^2/yr$, at stations A-1 and B-1 and multiplying the means by the ZZ area in km^2.

Since the soils, farming methods, and precipitation are very similar in the two areas (Wicks, 1977), nutrient loads for the Lake Griffin muck farms were based on estimates of loads in the Lake Apopka** drainage (125.7 kg P/day and 340.1 kg N/day; Anonymous, 1971) and the difference in pump capacities in the two areas; i.e., the combined capacity of the pumps at Lake Griffin was 44% of the combined capacity of the pumps discharging to Lake Apopka during the sampling year. The nutrient loads attributed to the Cattlemaster Farms were calculated using nutrient and pumpage data provided by the Lake County Department of Pollution Control (Hennessey, 1977).

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* See Working Paper No. 175.
** Working Paper No. 244.

The operator of the Leesburg wastewater treatment plant provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Leesburg	11,000	stab. pond	7,444.6	Lake Griffin

2. Known industrial - None

3. Known agricultural** -

Name	Type Waste	No. Pumps	Capacity (m^3/min)	Receiving Water (no. pumps)
Cattlemaster Farms	livestock pasturing	2	49.8	Lake Griffin (1), Haynes Creek (1)†
Eustis Muck Farms	muck farm	2	94.6	Yale-Griffin Canal
Knight & Sons Farms	muck farm	7	598.0	Lake Griffin (4), Haynes Creek (1)†, Yale-Griffin Canal (2)
Lake Land Farms & Baker Farms	} muck farm	1	83.3	Yale-Griffin Canal

* Treatment plant questionnaire.
** Hennessey, 1977; Wicks, 1977.
† Discharge downstream from Survey sampling station B-1.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Dead River	215	0.4
Haines Creek	20,030	39.8
b. Minor tributaries & immediate drainage (non-point load) -	4,370	8.7
c. Known municipal STP's -		
Leesburg	3,900	7.8
d. Septic tanks* -	35	<0.1
e. Known industrial - None	-	-
f. Known agricultural** -		
Muck farms	20,185	40.1
Cattlemaster Farm	10	<0.1
g. Direct precipitation*** -	1,570	3.1
Total	50,315	100.0

2. Outputs -

Lake outlet - Oklawaha River 29,225

3. Net annual P accumulation - 21,090 kg.

* Estimate based on 130 lakeshore dwellings; see Working Paper No. 175.
** See page 9.
*** Brezonik and Shannon, 1971.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/ yr	% of total
a. Tributaries (non-point load) -		
Dead River	4,640	0.5
Haines Creek	692,620	76.2
b. Minor tributaries & immediate drainage (non-point load) -	116,185	12.8
c. Known municipal STP's -		
Leesburg	18,210	2.0
d. Septic tanks* -	1,385	0.2
e. Known industrial - None	-	-
f. Known agricultural** -		
Muck farms	54,620	6.0
Cattlemaster Farm	70	<0.1
g. Direct precipitation*** -	20,650	2.3
Total	908,380	100.0

2. Outputs -

Lake outlet - Oklawaha River 913,825

3. Net annual N loss - 5,445 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Dead River	19	411
Haines Creek	12	413

* Estimate based on 130 lakeshore dwellings; see Working Paper No. 175.
** See page 9.
*** Brezonik and Shannon, 1971.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Note, however, that Florida lakes may be able to assimilate phosphorus at a somewhat higher level than that suggested by Vollenweider (Shannon and Brezonik, 1972).

Essentially, Vollenweider's "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible"

Vollenweider's model may not be applicable to water bodies with shore hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	1.41	0.59	25.5	loss*

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Lake Griffin:

"Dangerous" (eutrophic loading)	0.56
"Permissible" (oligotrophic loading)	0.28

* There was an apparent loss of nitrogen during the sampling year. This may have been due to nitrogen fixation in the lake, solubilization of previously sedimented nitrogen, recharge with nitrogen-rich ground water, or underestimation of the muck farm and/or minor tributary and immediate drainage loads. Whatever the cause, a similar nitrogen loss has occurred at Shagawa Lake, Minnesota, which has been intensively studied by EPA's former National Eutrophication and Lake Restoration Branch (Malueg et al., 1975).

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VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1201	ALLIGATOR LAKE	0.026	0.260	474.000	87.733	13.100	0.396
1202	LAKE APOPKA	0.102	0.230	464.176	46.611	8.200	0.019
1203	LAKE BANANA	0.060	0.260	482.667	208.600	3.600	0.293
1206	LAKE CRESCENT	0.065	0.130	473.884	10.211	10.200	0.033
1207	DUCTOWS LAKE	0.084	0.120	465.555	27.100	10.600	0.026
1208	LAKE DORA	0.102	0.240	482.869	54.978	7.400	0.022
1209	LAKE EFFIE	1.483	0.410	489.000	261.433	15.000	0.950
1210	LAKE GEORGE	0.129	0.165	469.308	35.090	11.000	0.063
1211	LAKE GIBSON	0.167	0.115	470.000	19.675	10.200	0.069
1212	GLENADA LAKE	0.134	0.165	454.167	27.667	14.700	0.072
1214	LAKE GRIFFIN	0.119	0.260	481.333	66.855	6.600	0.038
1215	LAKE HAINES	0.063	0.115	462.667	26.567	10.600	0.014
1217	LAKE HANCOCK	0.772	0.195	483.500	97.900	5.600	0.158
1219	LAKE HORSESHOE	0.034	0.130	459.000	12.067	11.500	0.023
1220	LAKE HOWELL	1.260	0.285	464.000	54.117	9.000	1.175
1221	LAKE ISTOKPOGA	0.039	0.120	464.222	6.594	8.600	0.010
1223	LAKE JESSUP	0.492	0.290	487.000	76.550	7.600	0.288
1224	LAKE KISSIMMEE	0.034	0.145	463.667	24.142	8.800	0.007
1227	LAKE LULU	1.490	1.065	483.000	276.566	14.300	1.030
1228	LAKE MARION	0.046	0.260	468.833	24.467	7.600	0.016
1229	LAKE MINNEHAHA	0.034	0.060	435.000	8.733	7.700	0.012
1230	LAKE MINNEOLA	0.018	0.070	406.333	3.333	7.400	0.009
1231	LAKE MONROE	0.188	0.300	474.555	14.225	10.800	0.128
1232	LAKE OKEECHOBEE	0.063	0.185	472.366	14.524	9.800	0.010
1234	LAKE POINSETT	0.085	0.150	469.000	6.500	10.600	0.031
1236	LAKE REEDY	0.031	0.330	468.500	34.837	10.600	0.006
1238	LAKE SOUTH	0.074	0.130	464.000	23.167	9.000	0.028
1239	LAKE TALQUIN	0.085	0.290	462.167	9.483	14.400	0.031

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1240	LAKE THONOTOSASSA	0.695	0.095	466.167	37.700	10.200	0.565
1241	LAKE TOHOPEKALIGA	0.246	0.200	472.917	30.633	10.500	0.152
1242	TROUT LAKE	1.110	0.650	472.000	76.967	12.900	0.470
1243	LAKE WEOHYAKAPKA	0.047	0.080	458.667	7.767	8.200	0.011
1246	LAKE YALE	0.027	0.160	441.000	25.367	7.600	0.014
1247	LAKE MUNSON	1.475	0.925	486.667	140.317	12.200	0.852
1248	LAKE SEMINOLE	0.234	0.175	473.833	102.000	8.600	0.026
1249	LAKE LAWNE	2.560	1.350	494.667	84.900	10.400	0.117
1250	LAKE TARPON	0.041	0.070	400.889	6.867	9.000	0.027
1252	LAKE ELOISE	0.486	0.170	465.333	70.233	12.200	0.339
1258	LAKE JESSIE	0.051	0.090	452.667	26.300	10.800	0.011
1261	EAST LAKE TOHOPEKALIGA	0.042	0.070	440.833	5.167	9.400	0.007
1264	PAYNE'S PRAIRIE LAKE (NO	1.260	0.140	476.000	88.200	7.400	1.210

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1201	ALLIGATOR LAKE	25 (10)	29 (10)	30 (12)	18 (7)	10 (4)	18 (7)	130
1202	LAKE APOPKA	50 (20)	38 (15)	10 (4)	38 (15)	74 (29)	70 (28)	280
1203	LAKE BANANA	23 (9)	29 (10)	20 (8)	5 (2)	100 (40)	23 (9)	200
1206	LAKE CRESCENT	65 (26)	70 (27)	33 (13)	80 (32)	48 (18)	50 (20)	346
1207	DOCTORS LAKE	60 (24)	76 (30)	60 (24)	55 (22)	34 (12)	56 (22)	341
1208	LAKE DORA	53 (21)	35 (14)	18 (7)	33 (13)	90 (35)	68 (27)	297
1209	LAKE EFFIE	5 (2)	10 (4)	3 (1)	3 (1)	0 (0)	10 (4)	31
1210	LAKE GEORGE	45 (18)	54 (21)	48 (19)	43 (17)	23 (9)	43 (17)	256
1211	LAKE GIBSON	40 (16)	81 (32)	45 (18)	70 (28)	48 (18)	40 (16)	324
1212	GLENADA LAKE	43 (17)	54 (21)	85 (34)	53 (21)	3 (1)	38 (15)	276
1214	LAKE GRIFFIN	48 (19)	29 (10)	23 (9)	30 (12)	95 (38)	48 (19)	273
1215	LAKE HAINES	70 (28)	81 (32)	75 (30)	58 (23)	34 (12)	78 (31)	396
1217	LAKE HANCOCK	18 (7)	43 (17)	13 (5)	13 (5)	98 (39)	28 (11)	213
1219	LAKE HORSESHOE	93 (37)	70 (27)	80 (32)	78 (31)	20 (8)	65 (26)	406
1220	LAKE HOWELL	11 (4)	23 (9)	69 (27)	35 (14)	60 (23)	3 (1)	201
1221	LAKE ISTOKPOGA	85 (34)	76 (30)	65 (26)	93 (37)	69 (27)	89 (35)	477
1223	LAKE JESSUP	28 (11)	18 (7)	5 (2)	25 (10)	83 (32)	25 (10)	184
1224	LAKE KISSIMMEE	90 (36)	63 (25)	73 (29)	65 (26)	65 (26)	99 (39)	455
1227	LAKE LULU	3 (1)	3 (1)	15 (6)	0 (0)	8 (3)	5 (2)	34
1228	LAKE MARION	78 (31)	29 (10)	53 (21)	50 (20)	83 (32)	73 (29)	366
1229	LAKE MINNEHAHA	88 (35)	91 (36)	95 (38)	85 (34)	78 (31)	80 (32)	517
1230	LAKE MINNEOLA	100 (40)	98 (38)	98 (39)	100 (40)	90 (35)	93 (37)	579
1231	LAKE MONROE	38 (15)	15 (6)	28 (11)	75 (30)	26 (10)	33 (13)	215
1232	LAKE OKEECHOBEE	68 (27)	45 (18)	40 (16)	73 (29)	53 (21)	89 (35)	368
1234	LAKE POINSETT	58 (23)	60 (24)	50 (20)	95 (38)	34 (12)	45 (18)	342
1236	LAKE REEDY	95 (38)	13 (5)	55 (22)	45 (18)	34 (12)	95 (38)	337
1238	LAKE SOUTH	63 (25)	70 (27)	69 (27)	68 (27)	60 (23)	56 (22)	386
1239	LAKE TALQUIN	55 (22)	20 (8)	78 (31)	83 (33)	5 (2)	53 (21)	294

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1240	LAKE THONOTOSASSA	20 (8)	85 (34)	58 (23)	40 (16)	48 (18)	15 (6)	265
1241	LAKE TOHOPEKALIGA	33 (13)	40 (16)	38 (15)	48 (19)	40 (16)	30 (12)	229
1242	TROUT LAKE	15 (6)	8 (3)	43 (17)	23 (9)	13 (5)	8 (3)	110
1243	LAKE WEOHYAKAPKA	75 (30)	91 (36)	83 (33)	88 (35)	74 (29)	84 (33)	495
1246	LAKE YALE	98 (39)	58 (23)	90 (36)	63 (25)	83 (32)	75 (30)	467
1247	LAKE MUNSON	8 (3)	5 (2)	8 (3)	8 (3)	16 (6)	13 (5)	58
1248	LAKE SEMINOLE	35 (14)	48 (19)	35 (14)	10 (4)	69 (27)	63 (25)	260
1249	LAKE LAWNE	0 (0)	0 (0)	0 (0)	20 (8)	43 (17)	35 (14)	98
1250	LAKE TARPON	83 (33)	98 (38)	100 (40)	90 (36)	60 (23)	60 (24)	491
1252	LAKE ELOISE	30 (12)	50 (20)	63 (25)	28 (11)	16 (6)	20 (8)	207
1258	LAKE JESSIE	73 (29)	88 (35)	88 (35)	60 (24)	26 (10)	84 (33)	419
1261	EAST LAKE TOHOPEKALIGA	80 (32)	98 (38)	93 (37)	98 (39)	55 (22)	99 (39)	523
1264	PAYNE'S PRAIRIE LAKE (NO	11 (4)	65 (26)	25 (10)	15 (6)	90 (35)	0 (0)	206

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1230	LAKE MINNEOLA	579
2	1261	EAST LAKE TOHOPEKALIGA	523
3	1229	LAKE MINNEHAHA	517
4	1243	LAKE WEOHYAKAPKA	495
5	1250	LAKE TARPON	491
6	1221	LAKE ISTOKPOGA	477
7	1246	LAKE YALE	467
8	1224	LAKE KISSIMMEE	455
9	1258	LAKE JESSIE	419
10	1219	LAKE HORSESHOE	406
11	1215	LAKE HAINES	396
12	1238	LAKE SOUTH	386
13	1232	LAKE OKEECHOBEE	368
14	1228	LAKE MARION	366
15	1206	LAKE CRESCENT	346
16	1234	LAKE POINSETT	342
17	1207	DOCTORS LAKE	341
18	1236	LAKE REEDY	337
19	1211	LAKE GIBSON	324
20	1208	LAKE DORA	297
21	1239	LAKE TALQUIN	294
22	1202	LAKE APOPKA	280
23	1212	GLENADA LAKE	276
24	1214	LAKE GRIFFIN	273
25	1240	LAKE THONOTOSASSA	266
26	1248	LAKE SEMINOLE	260
27	1210	LAKE GEORGE	256
28	1241	LAKE TOHOPEKALIGA	229

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	1231	LAKE MONROE	215
30	1217	LAKE HANCOCK	213
31	1252	LAKE ELOISE	207
32	1264	PAYNE'S PRAIRIE LAKE (NO	206
33	1220	LAKE HOWELL	201
34	1203	LAKE BANANA	200
35	1223	LAKE JESSUP	184
36	1201	ALLIGATOR LAKE	130
37	1242	TROUT LAKE	110
38	1249	LAKE LAWNE	98
39	1247	LAKE MUNSON	58
40	1227	LAKE LULU	34
41	1209	LAKE EFFIE	31

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR FLORIDA 8/25/75

LAKE CODE 1214 LAKE GRIFFIN

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 2007.2

NORMALIZED FLOWS(CMS)

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1214A1	11.3	0.05	0.07	0.07	0.06	0.05	0.04	0.05	0.06	0.06	0.07	0.05	0.05	0.06
1214B1	1678.3	7.99	9.49	10.39	9.51	7.50	6.65	6.99	8.27	9.74	8.86	7.70	7.31	8.36
1214D1	2007.2	9.40	11.04	11.84	10.82	8.07	7.25	8.07	9.60	10.62	11.02	9.20	8.58	9.62
1214ZZ	282.3	1.19	1.39	1.50	1.36	1.02	0.91	1.02	1.22	1.33	1.39	1.16	1.08	1.21

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 2007.2 TOTAL FLOW IN = 115.65
SUM OF SUB-DRAINAGE AREAS = 1971.9 TOTAL FLOW OUT = 115.50

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1214A1	3	73	0.03	18	0.02				
	4	73	0.05	8	0.08				
	5	73	0.01	13	0.01				
	6	73	0.03	14	0.01				
	7	73	0.01	8	0.01				
	8	73	0.02	5	0.03				
	9	73	0.03	8	0.01				
	10	73	0.03	14	0.02				
	11	73	0.01	4	0.01				
	12	73	0.02	9	0.01				
	1	74	0.02	6	0.03				
	2	74	0.01	2	0.01				
1214B1	3	73	8.07	18	15.29				
	4	73	6.74	8	6.23				
	5	73	2.01	13	0.17				
	6	73	1.08	14	0.85				
	7	73	3.00	8	0.91				
	8	73	13.68	5	15.46				
	9	73	7.45	8	11.69				
	10	73	1.27	14	0.85				
	11	73	2.63	4	2.75				
	12	73	0.99	9	0.08				
	1	74	0.88	6	0.91				
	2	74	0.96	2	0.85				

TRIBUTARY FLOW INFORMATION FOR FLORIDA 8/25/75

LAKE CODE 1214 LAKE GRIFFIN

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
121401	3	73	2.92	18	3.48				
	4	73	3.60	8	4.81				
	5	73	2.46	13	1.30				
	6	73	0.65	14	3.00				
	7	73	0.37	8	0.37				
	8	73	18.04	5	22.80				
	9	73	7.90	8	16.06				
	10	73	-0.25	14	0.03				
	11	73	-0.14	4	-0.17				
	12	73	3.85	9	16.17				
	1	74	0.65	6	0.37				
	2	74	1.02	2	0.96				
121422	3	73	0.65	18	0.42				
	4	73	1.13	8	1.98				
	5	73	0.23	13	0.20				
	6	73	0.76	14	0.11				
	7	73	0.23	8	0.17				
	8	73	0.51	5	0.71				
	9	73	0.65	8	0.37				
	10	73	0.68	14	0.51				
	11	73	0.17	4	0.20				
	12	73	0.45	9	0.25				
	1	74	0.48	6	0.76				
	2	74	0.11	2	0.17				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/08/25

121401
28 50 03.0 081 52 08.0
LAKE GRIFFIN
12069 FLORIDA

11EPALES
3

2111202
0005 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/14	09 45	0000	25.5	9.3	30	290	9.40	99	0.170	3.300	0.170	0.013
73/09/06	11 35	0000	29.7	8.4	16	292	9.00	86	0.090	4.000	0.110	0.027
73/11/05	15 25	0000	23.0		17	263	9.00	98	0.120	3.200	0.130	0.047
	15 25	0001	23.0	9.6		263						
	15 25	0004	23.0	9.0		260	8.90	99	0.140	3.600	0.170	0.052

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/14	09 45	0000	0.102	12.4
73/09/06	11 35	0000	0.122	74.0
73/11/05	15 25	0000	0.128	58.2
	15 25	0004	0.156	

STORET RETRIEVAL DATE 75/06/25

121402
28 50 17.0 081 50 52.0
LAKE GRIFFIN
12069 FLORIDA

11EPALES 2111202
3 0005 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/14	10 05	0000	25.5	9.1	15	290	9.30	100	0.160	2.200	0.160	0.012
73/09/06	11 20	0000	29.4	9.2	16	298	9.08	88	0.090	3.800	0.100	0.026
73/11/05	15 40	0000	22.1		19	261	8.90	100	0.120	3.300	0.130	0.055
	15 40	0001	22.1	8.8		261						
	15 40	0004	22.1	9.2		260	8.90	101	0.120	3.400	0.150	0.060

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/14	10 05	0000	0.095	28.0
73/09/06	11 20	0000	0.095	105.9
73/11/05	15 40	0000	0.125	82.6
	15 40	0004	0.123	

STORET RETRIEVAL DATE 75/08/25

121403
28 51 29.0 081 50 58.0
LAKE GRIFFIN
12059 FLORIDA

11EPALES 2111202
3 0005 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/14	10 15	0000	26.2	9.1	18	285	9.20	102	0.180	2.500	0.160	0.012
73/09/06	11 05	0000	29.4	8.6	24	292	8.98	98	0.090	3.600	0.110	0.030
73/11/05	15 15	0000	22.7		13	267	8.78	103	0.110	3.180	0.130	0.047
	15 15	0001	22.7	8.8		267						
	15 15	0004	22.6	8.8		267	8.70	102	0.130	3.080	0.150	0.059

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/14	10 15	0000	0.099	28.0
73/09/06	11 05	0000	0.083	117.8
73/11/05	15 15	0000	0.116	94.8
	15 15	0004	0.157	

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/08/25

1214A1
28 51 30.0 081 53 00.0
DEAD RIVER
12055 7.5 LEESBURG
T/LAKE GRIFFEN
ST HWY 466A BRDG NEAR LK GRIFFEN ST PARK
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/18	09 30		0.017	2.730	0.018	0.034	0.180
73/04/08	09 15		0.010K	2.300	0.016	0.032	0.130
73/05/13	08 25		0.010K	3.100	0.030	0.031	0.140
73/06/14	08 55		0.035	4.100	0.115	0.028	0.100
73/07/08	09 35		0.015	4.800	0.090	0.016	0.095
73/08/05	08 30		0.042	1.400	0.040	0.017	0.085
73/09/08	09 05		0.054	2.700	0.120	0.020	0.070
73/10/14	13 30		0.054	1.800	0.072	0.048	0.095
73/11/04	08 45		0.092	2.000	0.052	0.028	0.110
73/12/09	08 45		0.192	2.000	0.148	0.028	0.100
74/01/06	10 15		0.036	1.500	0.170	0.092	0.160
74/02/02	13 15		0.088	1.300	0.040	0.090	0.150

K VALUE KNOWN TO BE
LESS THAN INDICATED

TORET RETRIEVAL DATE 75/08/25

121481
28 52 30.0 081 47 00.0
HAINES CREEK
12 7.5 LEESBURG E
T/LAKE GRIFFEN
ST HWY 44 BRDG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/18	08 30		0.010K	2.800	0.010	0.019	0.105
73/04/08	10 15		0.010K	2.200	0.022	0.016	0.100
73/05/13	09 20		0.026	2.900	0.063	0.013	0.075
73/06/14	09 40		0.018	2.600	0.072	0.017	0.075
73/07/08	10 35		0.010K	3.100	0.044	0.008	0.065
73/08/05	09 20		0.020	2.400	0.134	0.029	0.110
73/09/08	09 02		0.013	2.200	0.132	0.015	0.052
73/10/14	14 30		0.025	2.100	0.440	0.027	0.040
73/11/04	10 10		0.450	2.300	0.024	0.016	0.060
73/12/09	09 35		0.108	1.800	0.300	0.028	0.060
74/01/06	11 10		0.064	3.050	0.470	0.024	0.075

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/08/25

121401
28 29 30.0 081 50 00.0
OKLAWAHA RIVER
12 7.5 EMERALDA ISL
O/LAKE GRIFFIN
ST HWY 42 BRDG W OF STARKES FERRY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/18	10 10		0.011	3.500	0.058	0.025	0.135
73/04/08	09 45		0.010K	2.900	0.052	0.024	0.115
73/05/13	08 50		0.010K	3.300	0.044	0.021	0.095
73/06/14	09 20		0.015	3.500	0.126	0.018	0.080
73/07/08	10 10		0.024	3.200	0.105	0.010	0.065
73/08/05	09 00		0.021	3.200	0.273	0.018	0.095
73/09/08	09 30		0.030	3.900	0.072	0.012	0.075
73/10/14	14 00		0.010K	2.200	0.220	0.025	0.095
73/11/04	09 30		0.044	1.600	0.024	0.012	0.090
73/12/09	09 10		0.014	2.100	0.060	0.024	0.110
74/01/06	10 45		0.028	2.000	0.100	0.020	0.080
74/02/02	13 40		0.008	1.400	0.015	0.020	0.085

K VALUE KNOWN TO BE
LESS THAN INDICATED

IORET RETRIEVAL DATE 75/08/25

1214EA P01214EA P011000
28 49 00.0 081 52 00.0
LEESBURG
12055 7.5 LEEBURG EAST
D/LAKE GRIFFIN
LAKE GRIFFIN
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/02/05 CP(T)- 73/02/06	23 30 23 30		2.200	1.100	0.045	1.800	1.900	2.180	2.090
73/03/14 CP(T)- 73/03/15	23 00 23 00		3.570	1.550	0.110	3.200	3.200	2.100	2.200
73/04/09 CP(T)- 73/04/10	23 00 23 00		3.400	15.400	0.120	2.400	2.400	2.170	2.030
73/05/06 CP(T)- 73/05/07	11 00 11 00		2.000	1.600	0.110	2.600	2.700	1.860	2.120
73/06/18 CP(T)- 73/06/18	11 30 23 30		2.600	0.150	0.013	0.720	0.930	2.110	2.070
73/07/10 CP(T)- 73/07/11	23 00 23 00		2.300	2.100	0.054	0.802	1.050	2.100	2.200
73/08/07 CP(T)- 73/08/07	06 00 23 00		2.520	2.200	0.058	0.385	0.600	2.130	1.980
73/09/10 CP(T)- 73/09/10	11 00 23 00		3.700	2.100	0.198	0.495	0.660	1.920	2.030
73/10/21 CP(T)- 73/10/22	23 00 23 00		7.900	1.150	0.038	0.720	0.830	1.820	1.880
73/11/18 CP(T)- 73/11/19	23 00 23 00		12.000	1.200	0.040	0.690	1.020	1.330	1.720
73/12/09 CP(T)- 73/12/10	23 00 23 00		4.300	1.000	0.110	0.470	0.480	1.630	1.550
74/01/09 CP(T)- 74/01/09	11 00 11 00		4.400	1.600	0.040K	0.910	1.000	1.890	1.730

K VALUE KNOWN TO BE
LESS THAN INDICATED